WE CLAIM:

1. A fuel cell system, comprising:

a fuel processing assembly adapted to produce a product hydrogen stream containing at least substantially pure hydrogen gas from at least one feed stream;

an air delivery system adapted to receive an air stream having a concentration of oxygen gas and to produce therefrom an oxygen-enriched stream having a greater concentration of oxygen gas than the air stream, wherein the air delivery system includes at least one oxygen-enrichment assembly adapted to produce the oxygen-enriched stream from the air stream;

a fuel cell stack adapted to receive at least a portion of the product hydrogen stream and the oxygen-enriched stream and to produce an electric current therefrom; wherein the fuel cell stack is adapted to emit a cathode exhaust stream containing water; and

a water-recovery assembly adapted to receive the cathode exhaust stream and to produce a product water stream therefrom.

2. The system of claim 1, wherein the at least one feed stream comprises water.

3. The system of claim 2, wherein the product water stream forms at least 50% of the water present in the at least one feed stream.

4. The system of claim 3, wherein the product water stream forms at least 90% of the water present in the at least one feed stream.

5. The system of claim 1, wherein the at least one feed stream comprises water and at least one carbon-containing feedstock.

6. The system of claim 5, wherein the product water stream forms at least 50% of the water present in the at least one feed stream.

7. The system of claim 5, wherein the fuel processing assembly is adapted to produce the product hydrogen stream by steam reforming of the at least one feed stream.

8. The system of claim 1, further comprising at least one separation region adapted to selectively reduce the concentration of impurities present in the product hydrogen stream.

9. The system of claim 1, wherein the oxygen-enrichment assembly is adapted to selectively remove at least nitrogen gas from the air stream.

10. The system of claim 1, wherein the oxygen-enrichment assembly is adapted to separate the air stream into the oxygen-enriched stream having a greater concentration of oxygen gas than the concentration of oxygen gas in the air stream and an oxygen-depleted stream containing a greater concentration of nitrogen gas than present in the air stream.

11. The system of claim 1, wherein the oxygen-enrichment assembly includes at least one oxygen-selective membrane, with the oxygen-enriched stream containing portions of the air stream that pass through the at least one oxygen-selective membrane.

12. The system of claim 1, wherein the oxygen-enrichment assembly includes at least one pressure swing adsorption assembly adapted to produce the oxygen-enriched stream from the air stream.

13. The system of claim 1, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream containing at least 30% oxygen.

14. The system of claim 1, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream containing at least 50% oxygen.

15. The system of claim 1, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream containing at least 75% oxygen.

16. The system of claim 1, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream having a concentration of oxygen gas that is at least 50% greater than the concentration of oxygen gas in the air stream.

17. The system of claim 1, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream having a concentration of oxygen gas that is at least 100% greater than the concentration of oxygen gas in the air stream.

18. The system of claim 1, wherein the water-recovery assembly includes at least one water-permeable membrane, with the product water stream being formed from water that passes through the at least one water-permeable membrane.

19. The system of claim 1, wherein the water-recovery assembly is adapted to deliver the product water stream to a potable water supply.

20. The system of claim 1, wherein the fuel processing assembly is adapted to receive and utilize at least a portion of the at least one feed stream and at least a portion of the product water stream.

21. The system of claim 1, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream having an oxygen concentration that is at least 30% greater than the concentration of oxygen gas in the air stream and the water-recovery assembly is adapted to produce a product water stream having a flow rate that is at least 50% as great as the flow rate of water in the at least one feed stream for the fuel processing assembly.

22. The system of claim 1, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream having an oxygen concentration that is at least 30% greater than the concentration of oxygen gas in the air stream and the water-recovery assembly is adapted to produce a product water stream having a flow rate that is at least 75% as great as the flow rate of water in the at least one feed stream for the fuel processing assembly.

23. The system of claim 1, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream having an oxygen concentration that is at least 30% greater than the concentration of oxygen gas in the air stream and the water-recovery assembly is adapted to produce a product water stream having a flow rate that is at least 100% as great as the flow rate of water in the at least one feed stream for the fuel processing assembly.

24. The system of claim 1, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream having an oxygen concentration that is at least 100% greater than the concentration of oxygen gas in the air stream and the water-recovery assembly is adapted to produce a product water stream having a flow rate that is at least 50% as great as the flow rate of water in the at least one feed stream for the fuel processing assembly.

25. The system of claim 1, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream having an oxygen concentration that is at least 100% greater than the concentration of oxygen gas in the air stream and the water-recovery assembly is adapted to produce a product water stream having a flow rate that is at least 75% as great as the flow rate of water in the at least one feed stream for the fuel processing assembly.

26. The system of claim 1, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream having an oxygen concentration that is at least 100% greater than the concentration of oxygen gas in the air stream and the water-recovery assembly is adapted to produce a product water stream having a flow rate that is at least 100% as great as the flow rate of water in the at least one feed stream for the fuel processing assembly.

27. A method for operating a fuel cell system, the method comprising:

receiving an air stream having a concentration of oxygen gas;

producing from the air stream an oxygen-enriched stream containing a higher concentration of oxygen gas than the concentration of oxygen gas in the air stream;

delivering the oxygen-enriched stream to a cathode region of a fuel cell stack adapted to produce an electric current and water from the oxygen-enriched stream and a fuel stream, wherein the fuel cell stack is adapted to exhaust at least a cathode exhaust stream containing water;

recovering water from the cathode exhaust stream; and

utilizing at least a portion of the recovered water to produce additional fuel for the fuel stream.

28. The method of claim 27, wherein the fuel is hydrogen gas and the fuel stream contains at least substantially pure hydrogen gas.

29. The method of claim 27, wherein the producing step includes producing an oxygen-enriched stream containing at least 30% oxygen.

30. The method of claim 27, wherein the producing step includes producing an oxygen-enriched stream containing at least 50% oxygen.

31. The method of claim 27, wherein the producing step includes producing an oxygen-enriched stream having a concentration of oxygen gas that is at least 50% as great as the concentration of oxygen gas in the air stream.

32. The method of claim 27, wherein the producing step includes producing an oxygen-enriched stream having a concentration of oxygen gas that is at least 100% as great as the concentration of oxygen gas in the air stream.

33. The method of claim 27, wherein the fuel is hydrogen gas, the fuel stream includes at least water, and the utilizing step includes producing hydrogen gas from at least one feed stream, with the at least one feed stream including water recovered from the cathode exhaust stream.

34. The method of claim 33, wherein the at least one feed stream further comprises at least one carbon-containing feedstock.

35. The method of claim 34, wherein the utilizing step includes producing hydrogen gas by steam reforming water and the at least one carbon-containing feedstock.

36. A method for operating a fuel cell system, the method comprising:

producing from at least one feed stream comprising water and at least one carbon-containing feedstock a product hydrogen stream in a hydrogen-producing region of a fuel processing assembly;

receiving an air stream having a concentration of oxygen gas;

producing from the air stream an oxygen-enriched stream containing at least 50% greater concentration of oxygen gas than the concentration of oxygen gas in the air stream;

delivering at least a portion of the product hydrogen stream to an anode region of a fuel cell stack and at least a portion of the oxygen-enriched stream to a cathode region of a fuel cell stack;

producing water and an electric current from the portions of the product hydrogen stream and the oxygen-enriched stream in the fuel cell stack;

exhausting from the cathode region a cathode exhaust stream containing water;

recovering water from the cathode exhaust stream; and

delivering water recovered from the cathode exhaust stream to the hydrogen-producing region as at least a portion of the at least one feed stream for the production of additional amounts of the product hydrogen stream.

37. In a fuel cell system having a fuel processing assembly adapted to produce a product hydrogen stream from at least one feed stream, a fuel cell stack adapted to produce water and an electric current from at least a portion of the product hydrogen stream and an oxidant stream containing oxygen gas, the improvement comprising:

an air delivery system including at least one oxygen-enrichment assembly adapted to receive an air stream having a concentration of oxygen gas and to produce therefrom the oxidant stream having a greater concentration of oxygen gas than the air stream; and

a water-recovery assembly adapted to receive a cathode exhaust stream from the fuel cell stack and to produce a recovered water stream containing water recovered from the cathode exhaust stream; wherein the fuel processing assembly is adapted to receive at least a portion of the recovered water and to utilize the recovered water as a feedstock for producing the product hydrogen stream.

38. The system of claim 37, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream having an oxygen concentration that is at least 30% greater than the concentration of oxygen gas in the air stream and the water-recovery assembly is adapted to produce a recovered water stream having a flow rate that is at least 50% as great as the flow rate of water in the at least one feed stream for the fuel processing assembly.

39. The system of claim 37, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream having an oxygen concentration that is at least 30% greater than the concentration of oxygen gas in the air stream and the water-recovery assembly is adapted to produce a recovered water stream having a flow rate that is at least 75% as great as the flow rate of water in the at least one feed stream for the fuel processing assembly.

40. The system of claim 37, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream having an oxygen concentration that is at least 30% greater than the concentration of oxygen gas in the air stream and the water-recovery assembly is adapted to produce a recovered water stream having a flow rate that is at least 100% as great as the flow rate of water in the at least one feed stream for the fuel processing assembly.

41. The system of claim 37, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream having an oxygen concentration that is at least 100% greater than the concentration of oxygen gas in the air stream and the water-recovery assembly is adapted to produce a recovered water stream having a flow rate that is at least 50% as great as the flow rate of water in the at least one feed stream for the fuel processing assembly.

42. The system of claim 37, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream having an oxygen concentration that is at least 100% greater than the concentration of oxygen gas in the air stream and the water-recovery assembly is adapted to produce a recovered water stream having a flow rate that is at least 75% as great as the flow rate of water in the at least one feed stream for the fuel processing assembly.

43. The system of claim 37, wherein the oxygen-enrichment assembly is adapted to produce an oxygen-enriched stream having an oxygen concentration that is at least 100% greater than the concentration of oxygen gas in the air stream and the water-recovery assembly is adapted to produce a recovered water stream having a flow rate that is at least 100% as great as the flow rate of water in the at least one feed stream for the fuel processing assembly.